



EV Grid Integration

Why It's Important, Methods, Case Studies

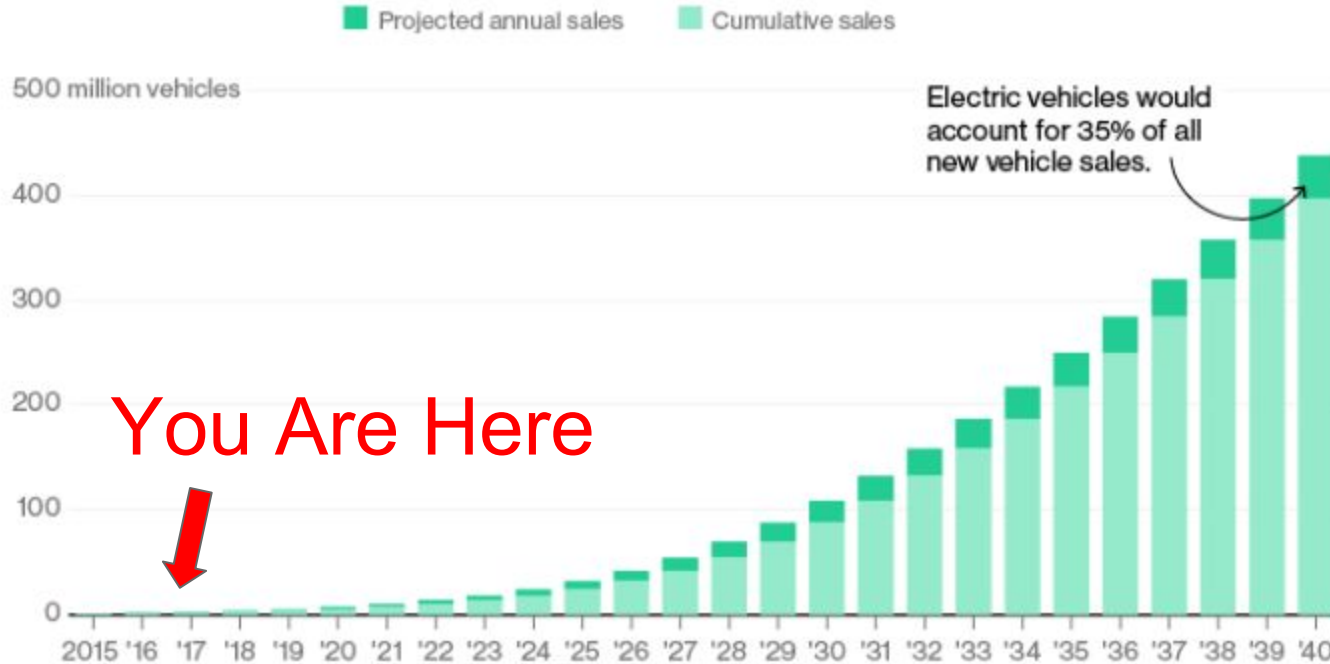
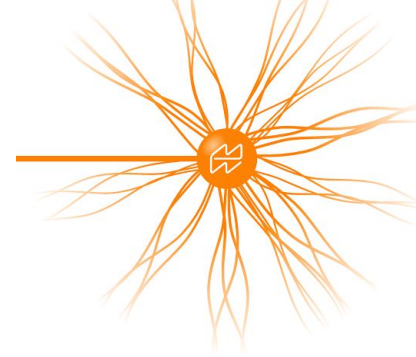
Smart Cities Columbus

Preston Roper
COO, eMotorWerks

2 November 2016

The Rise of Electric Cars

By 2022 electric vehicles will cost the same as their internal-combustion counterparts. That's the point of liftoff for sales.



Sources: Data compiled by Bloomberg New Energy Finance, Marklines

Bloomberg

eMotorWerks
SMART [GRID] EV CHARGING

EV Storage - Large, Highly Shift-able Load



Today!

(~200,000 EVs)

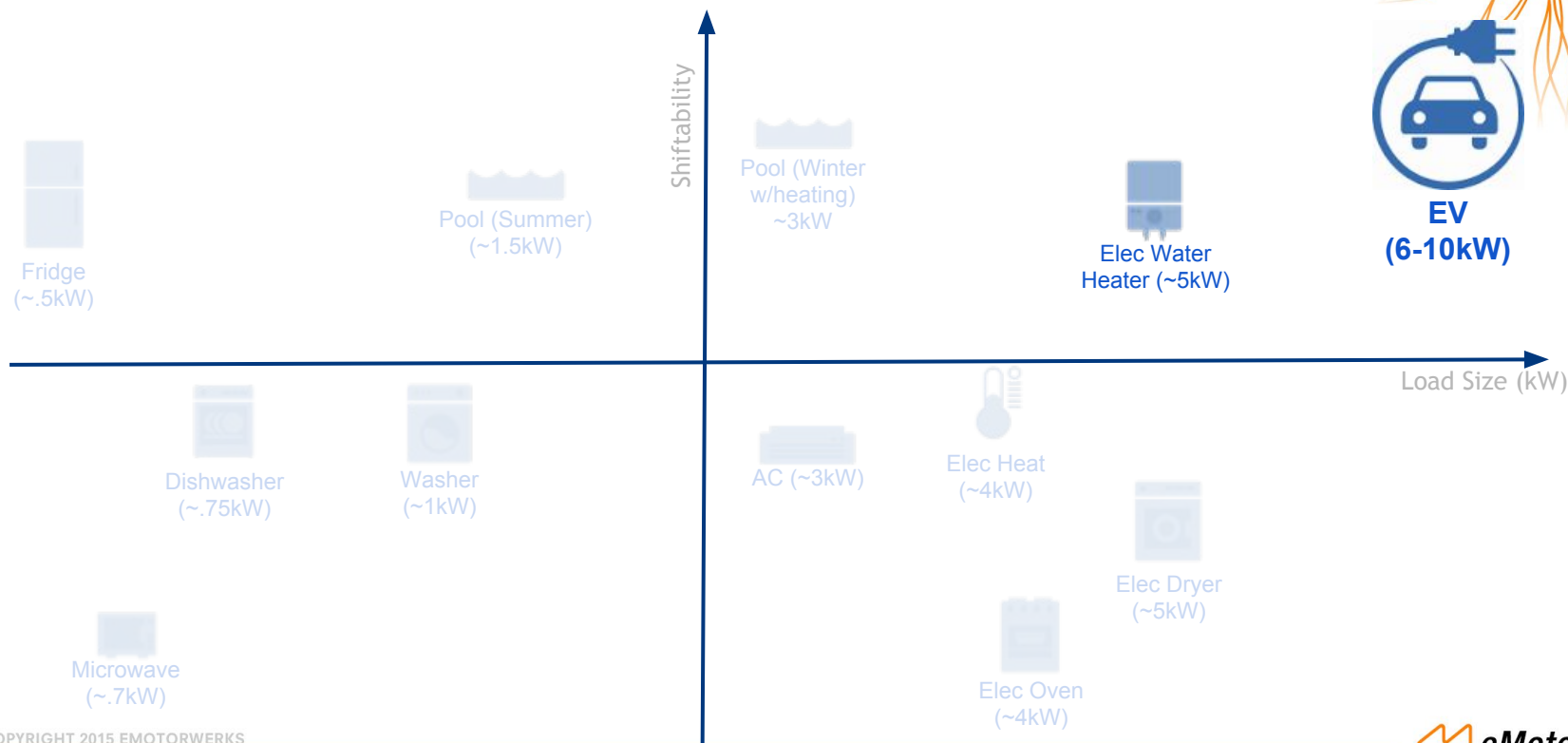


**= 6 GWH
capacity**

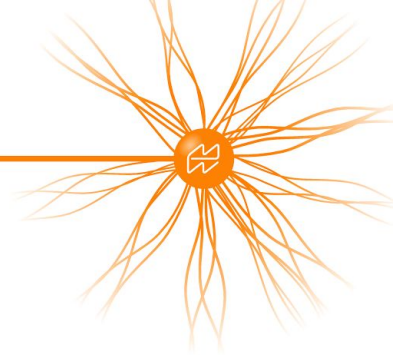
= 1200 MW

**= 912 GWH
energy per
year**

EV Charging - Largest & Most Flexible Load

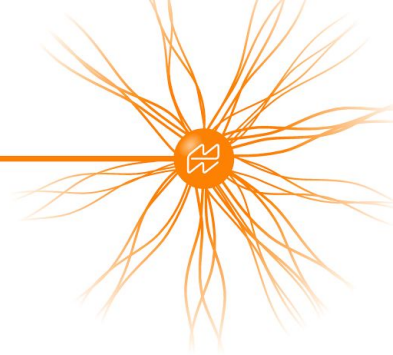


JuiceNet[®] Energy Services Platform



- Modulate large, distributed, shiftable loads such as EVs, water heaters
 - Avoid high-cost peak generation
 - Defer costly grid upgrades
 - Improve grid reliability
 - Integrate more renewables into the grid

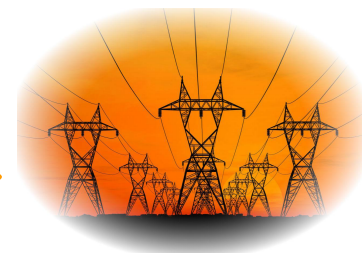
EV Centric “Internet of Load” Platform



- Precise load control
- 3-second control latency
- Instant local grid response
- Remote control API



- Predictive grid model
- Predictive, self-learning driver model
- Cloud-based load management & dispatch
- Cloud-based market engine



Demand Flexibility:

Estimated savings of
\$9B/year grid investment
and \$4B/year in energy and
ancillary services costs¹

Heterogenous EV Load Access

Better EV Driver Experience & Incentives



Smart Stations

Amazon best-seller, 12,000+ stations sold, partner to access 50,000+



JuicePlug™

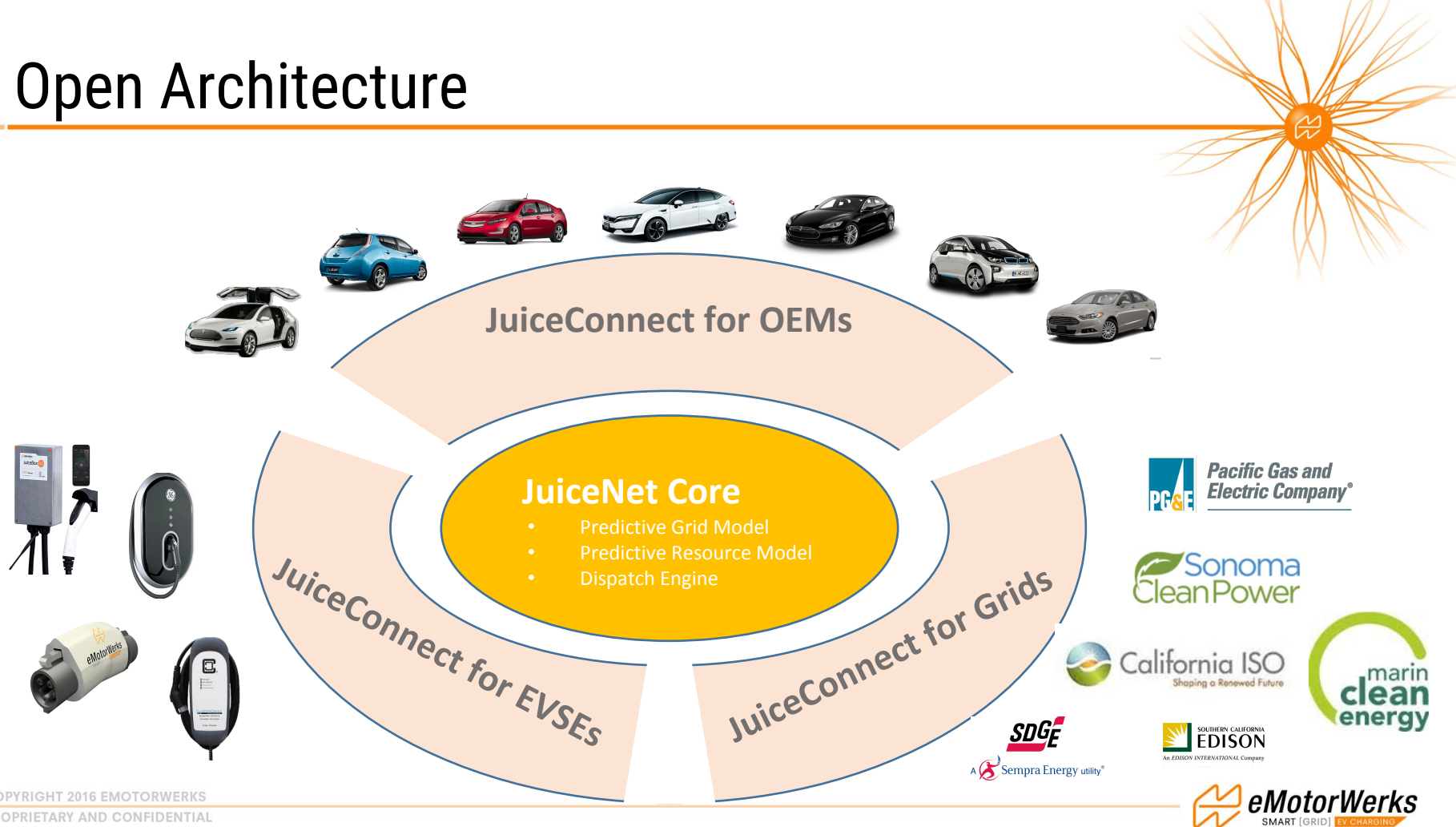
Makes any EV charging smart. Immediate access to the entire EV installed base



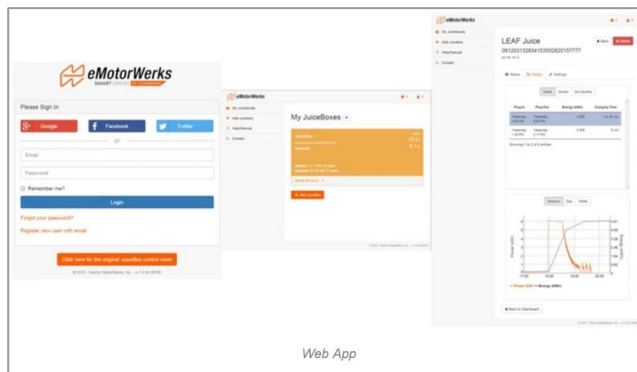
Direct EV Control

JuiceNet Cloud-to-OEM Cloud

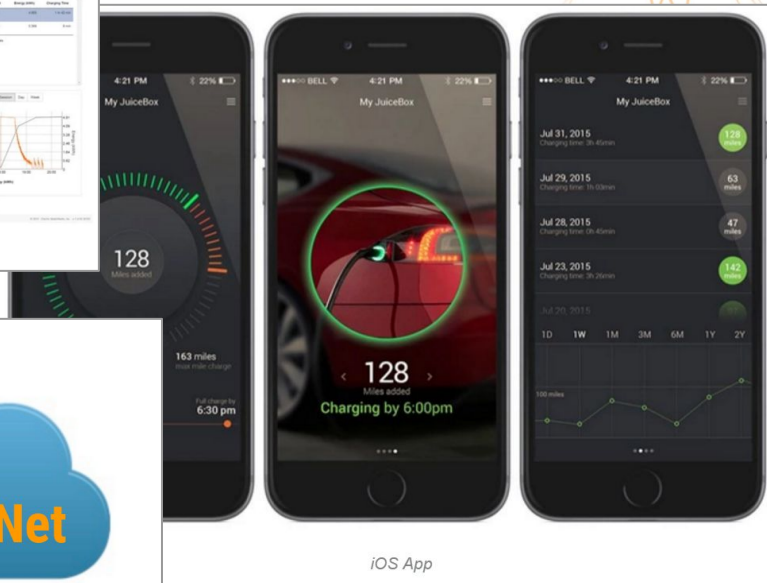
Open Architecture



Driver Access: App, Portal, Home Automation



Web App



iOS App

Case Study 1: CPUC Submetering Pilot



- EVSE-as-a-revenue submeter - 12-month review:
 - Deployed across 3 CA IOUs for billing data
 - JuiceBox/JuiceNet: 98% of the pilot EVSEs, 240 stations
 - Saved CPUC between \$2,500 and \$10,000 CAPEX per ratepayer



**Pacific Gas and
Electric Company®**

- Customer Benefits:
 - Lower cost sub-metering alternative
 - Saved \$800-1000 / year in energy costs via EV ToU tariff

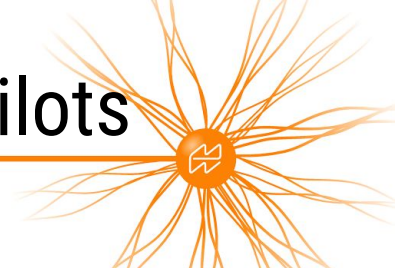


- Phase II plan
 - Commences 1Q17, ~1,000 additional EVs



- Recommendation
 - ***Enable broadscale, low-cost revenue submetering via EVSEs***

Case Study 2: Supply-Side & Excess-Supply Pilots



- Precursor to CA DRAM, sponsored by PG&E
 - CAISO wholesale market participation for PDR resources
 - Bidding and settlement based on market performance
 - Goals: address intermittency, facilitate renewables
- Over 100 eMotorWerks customers currently participating
 - Scalable DERs aggregation
 - Utility and CAISO signal response
- **Recommendation**
 - ***Modernize customer validation & DER enrollment, e.g. secure API-based communications***
 - ***Simplify/eliminate cumbersome end-user agreements***



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Case Study 3: CA DRAM - Key Industry Milestone



- Pay-as-bid auction, with monthly system resource adequacy (RA)
- Sellers can also offer directly into the CAISO day-ahead or real-time energy market
- eMotorWerks: only successful bidder providing resources from EVs → all 3 IOU's
- **Recommendation - setup economically-viable programs early**
 - ***Ensure heterogeneous EVSE support***
 - ***Target for "critical mass" geographic concentration***
 - ***Enable incentives "quiltwork", e.g.***
 - ***Broad time of day***
 - ***Range of monetizable DER services***
 - ***Enable DER aggregation across geographies, e.g. SLAPs (?)***



Case Study 4 & 5: Muni & CCA Innovation



- Rich incentives to meet customer demand
- up to \$1,000
- Multi-vendor EVSE support
- Joint outreach and customer support -
“Concierge” charging programs
- DRAM, day-ahead, and real-time market participation,
with goal of increasing ROI of local renewable energy
projects within resp. service territories
- **Recommendation**
Innovate and learn from early deployments

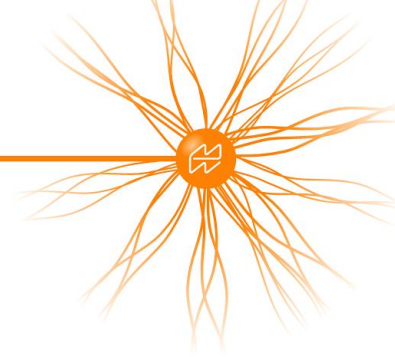


SmartCharge EV Pilot Program



HOME BUSINESS RESIDENTIAL YOUR OPTIONS





Thank You!

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